

Listed below is a clean copy of amended claims. A marked-up copy of the amended claims is provided in an accompanying document.

~~1038~~. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters positioned in one or more wellbores to at least a portion of the formation;

establishing a pyrolysis zone in at least the portion of the formation;

allowing the heat to transfer from the one or more heaters to the pyrolysis zone of the formation;

E1. controlling a pressure and a temperature in at least a majority of the pyrolysis zone, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure;

controlling a pressure in the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than 25; and

producing a mixture from the formation.

~~1039~~. (amended) The method of claim ~~1038~~, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons in the pyrolysis zone of the formation.

E2. ~~1035~~. (amended) The method of claim ~~1034~~, wherein controlling the temperature comprises maintaining a temperature within the pyrolysis zone in a pyrolysis temperature range.

E3. ~~1037~~. (amended) The method of claim ~~1036~~, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons in the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the

E3 selected volume is about 10 °C/day.

E4 ~~1069.~~ (amended) The method of claim ~~1058~~, wherein providing heat from the one or more heaters comprises heating the pyrolysis zone such that a thermal conductivity of at least a portion of the pyrolysis zone is greater than about 0.5 W/(m °C).

E5 ~~1082.~~ (amended) The method of claim ~~1058~~, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

~~212~~ ~~1085.~~ (amended) The method of claim ~~1058~~, further comprising controlling the pressure in at least a majority of the pyrolysis zone of the formation, wherein the controlled pressure is at least about 2.0 bars absolute.

E6 ~~21~~ ~~1086.~~ (amended) The method of claim ~~1058~~, further comprising controlling formation conditions to produce a mixture of condensable hydrocarbons and H₂, wherein a partial pressure of H₂ in the mixture is greater than about 0.5 bar.

E7 ~~30~~ ~~1089.~~ (amended) The method of claim ~~1058~~, further comprising:
providing hydrogen (H₂) to the pyrolysis zone to hydrogenate hydrocarbons in the pyrolysis zone; and
heating a portion of the pyrolysis zone with heat from hydrogenation.

E8 ~~31~~ ~~1091.~~ (amended) The method of claim ~~1058~~, wherein allowing the heat to transfer increases a permeability of a majority of the pyrolysis zone to greater than about 100 millidarcy.

~~33~~ ~~1092.~~ (amended) The method of claim ~~1058~~, wherein allowing the heat to transfer increases a

E8 permeability of a majority of the pyrolysis zone such that the permeability of the majority of the pyrolysis zone is substantially uniform.

~~41~~ 5442. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters to at least a portion of the formation, wherein one or more heaters provides a heat output of less than about 1650 watts per meter;
E9 establishing a pyrolysis zone in at least a portion of the formation;
allowing the heat to transfer from the one or more heaters to the pyrolysis zone of the formation;

controlling a pressure and a temperature in at least a majority of the pyrolysis zone, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure;

controlling a pressure in the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than 25; and

producing a mixture from the formation.

43 ~~41~~ 5444. (amended) The method of claim ~~41~~ 5442, wherein at least one of the heaters comprises a natural distributed combustor.

E10 ~~41~~ 5445. (amended) The method of claim ~~41~~ 5442, wherein at least one of the heaters is disposed in an open wellbore.

~~41~~ 5448. (amended) The method of claim ~~41~~ 5442, wherein providing heat from the one or more heaters to the portion of the formation comprises:

E11 heating a selected volume (V) of the formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons in the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

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5449. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters to at least a portion of the formation;
allowing the heat to transfer from the one or more heaters to a part of the formation;
controlling a pressure and a temperature in at least a majority of the part of the formation,
wherein the pressure is controlled as a function of temperature, or the temperature is controlled
as a function of pressure;

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controlling a pressure in the formation to inhibit production of hydrocarbons from the
formation having carbon numbers greater than 25; and
producing a mixture from the formation, wherein the mixture comprises condensable
hydrocarbons.

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5451. (amended) The method of claim 5449, further comprising establishing a pyrolysis zone
in the part of the formation.

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5452. (amended) The method of claim 5449, wherein at least one of the heaters comprises a
natural distributed combustor.

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5453. (amended) The method of claim 5449, wherein at least one of the heaters is disposed in
an open wellbore.

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5456. (amended) The method of claim 5449, wherein providing heat from the one or more
heaters to the portion of the formation comprises:

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heating a selected volume (V) of the formation from one or more of the heaters, wherein
the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some
hydrocarbons in the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than
 $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the
selected volume is about 10 °C/day.

Response to Office Action Mailed March 24, 2003

A. Pending Claims

Claims 1058-1063, 1065-1067, 1069-1096, 5397, 5440-5446, 5448-5454, and 5456 are pending in the case. Claims 1058, 1059, 1065, 1067, 1069, 1082, 1085, 1086, 1089, 1091, 1092, 5442, 5444, 5445, 5448, 5449, 5451-5453, and 5456 have been amended. Claims 1059, 1065, 1067, 1069, 1082, 1085, 1086, 1089, 1091, 1092, 5444, 5445, 5448, 5451-5453, and 5456 have been amended for clarification. Claims 1064, 1068, 5447, and 5455 have been cancelled.

B. The Claims Are Definite Pursuant To 35 U.S.C. § 112, Second Paragraph

The Examiner rejected claims 1058, 1059, 1063-1096, 5397, 5440-5448, and 5451 under 35 U.S.C. 112, second paragraph, as "being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention." Applicant respectfully disagrees with the rejections.

The Examiner states: "The specification notwithstanding, it is still deemed that claim 1058 is indefinite. In this regard, the method of claim 1058 is directed to a method of treating a hydrocarbon formation. In the initial 'providing' step, a 'portion' of the formation is referred to. Then in the 'allowing' step, 'a pyrolysis zone' is simply recited. Since such 'pyrolysis zone' would not be naturally occurring in a subterranean hydrocarbon formation, it is unclear how it occurs in the formation.... Claims 1059, 1063-1096, 5397, 5440 and 5441 are still deemed indefinite insofar as they depend from claim 1058. Claims 5442-5448 and 5451 are similarly indefinite with respect to the recitation 'a pyrolysis zone'."

Amended claims 1058 and 5442 describe a combination of features including: "establishing a pyrolysis zone in at least the portion of the formation". Amended claim 5451 describes a combination of features including: "establishing a pyrolysis zone in the part of the

formation.” Applicant respectfully requests removal of the rejections of claims 1058, 1059, 1063-1096, 5397, 5440-5448, and 5451.

C. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 1058-1096, 5397, and 5440-5456 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1058-1096 of copending U.S. Patent Application No. 09/841,441. Applicant disagrees that a terminal disclaimer is needed over copending application No. 09/841,441. In the interest of expediency, however, a terminal disclaimer is being submitted in a separate document.

The Examiner states that claim 81 currently pending in U.S. Patent Application No. 09/841,432 is an obvious variation of claim 1068 pending in the the instant application. Applicant disagrees that claim 1068 is an obvious variation of claim 81 currently pending in U.S. Patent Application No. 09/841,432. In the interest of expediency, however, claim 1068 has been cancelled.

D. The Claims Are Not Anticipated By Schlinger and Slater Pursuant To 35 U.S.C. § 102(b), or in the Alternative, Are Not Obvious Over Schlinger and Slater Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1058, 1059, 1063, 1065-1086, 1088, 1089, 1091-1093, 5440-5446, 5448-5454, and 5456 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, obvious under 35 U.S.C. 103(a) over U.S. Patent No. 3,617,471 to Schlinger et al. (hereinafter “Schlinger”) and U.S. Patent No. 3,084,919 to Slater (hereinafter “Slater”). Applicant respectfully disagrees with these rejections.

In item 14 of the Office Action, the Examiner states: “It is noted that claims 1064, 1087, 1094, 5397, 5447 and 5455 are rejected above only under obviousness double patenting.”

Independent claim 1058 has been amended to include the features of claim 1064.

Independent claim 5442 has been amended to include the features of claim 5447. Independent claim 5449 has been amended to include the features of claim 5455. Amended claims 1058 and 5442 describe a combination of features including: "controlling a pressure and a temperature within at least a majority of the pyrolysis zone, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure." Amended claim 5449 describes a combination of features including: "controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure." Applicant respectfully requests removal of the rejections of claims 1058, 5442, and 5449 and the claims dependent thereon.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed. Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed. Cir. 1985).

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03. If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). In addition, Applicant submits that many of the claims dependent on claims 1058, 5442, and 5449 are separately patentable.

The Examiner states: "With regard to claims 1066, 1067 and 1068, it is maintained that such heating rates and thermal conductivity would be encompassed or dictated by the characteristics and properties of the oil shale formation actually encountered in the field."

Schlinger and/or Slater do not appear to teach or suggest the features of claim 1066 including “controlling a heating rate such that an average heating rate of the pyrolysis zone is less than about 1 °C per day during pyrolysis”. The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). “To establish inherency, the extrinsic evidence ‘must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.’” *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999). In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). Applicant respectfully requests removal of the rejection of claim 1066.

Amended claim 1067 describes a combination of features including: “wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.” Applicant submits that the recited heating rate has criticality and/or unexpected results not taught or suggested by the cited art. Applicant’s Specification discloses: “In an alternative embodiment, at least a portion of the formation may be heated to a temperature such that at least a portion of the hydrocarbon containing formation may be converted to coke and/or char. Coke and/or char may be formed at temperatures above about 400 °C and at a high heating rate (e.g., above about 10 °C/day).” (Specification, page 82, lines 11-14) Schlinger and/or Slater do not appear to teach or suggest using a desired heating rate to calculate a maximum average heating energy/day to be applied to a selected volume of a formation. Applicant respectfully requests removal of the rejection of claim 1067.

The Examiner states:

Regarding claims 1070-1084, Schlinger et al makes repeated references to an exemplary hydrocarbon production mixture, such as “superior quality” shale oil, “greater amount of the desirable middle distillate material”, “shale oil of improved quality and containing a greater amount of C6 material” (col. 4, lines 9-17), “unusually high yield of high quality product shale oil”, and further observes that “the sulfur and nitrogen content of our shale oil ... 25 to 35 percent lower” (col. 4, lines 22-29). Thus it is deemed that Schlinger et al tailors their process, e.g., by pressure control, to obtain specific hydrocarbon production effluent, as per applicant’s invention.

Table 1 of Schlinger shows a maximum value of API gravity for product shale oil of 24.5° and a minimum value of weight percent nitrogen of 1.65. Claims 1070, 5446, and 5454 describe features including: “wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.” Claim 1074 describes features including: “wherein less than about 1 % by weight, when calculated on an atomic basis, of the non-aqueous portion is nitrogen.” Applicant respectfully requests removal of the rejections of claims 1070 and 1074.

Claims 1071-1073 and 1075-1084 describe a combination of features including producing mixtures with various combinations and concentrations of components. Applicant submits that Schlinger and/or Slater do not appear to teach or suggest specific values or ranges of values for these components. Applicant respectfully requests removal of the rejections of claims 1071-1073 and 1075-1084.

The Examiner states: “With regard to claims 1091 and 1092, Schlinger et al makes clear reference to fracturing of the oil shale formation during the heating process, and further that ‘the porous structure of the shale is maintained during retorting to enable cracked Kerogen in the interior to quickly escape’ (col. 5, lines 10-17).”

Amended claim 1091 describes a combination of features including: “wherein allowing the heat to transfer increases a permeability of a majority of the pyrolysis zone to greater than about 100 millidarcy.” Amended claim 1092 describes a combination of features including:

“wherein allowing the heat to transfer increases a permeability of a majority of the pyrolysis zone such that the permeability of the majority of the pyrolysis zone is substantially uniform.”

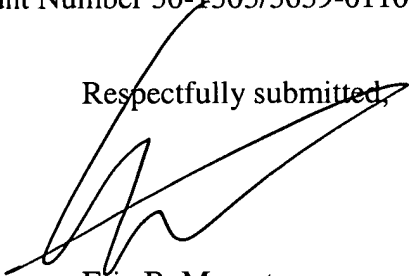
Schlinger appears to teach or suggest *maintaining* a porous structure of the shale. Schlinger does not appear to teach or suggest *increasing* a permeability of a majority of the pyrolysis zone nor does Schlinger appear to teach or suggest a value of the permeability. Applicant respectfully requests removal of the rejections of claims 1091 and 1092.

E. Additional Comments

Applicant submits that all claims are in condition for allowance. Applicant submits that the amendments do not require any further search on the part of the Examiner. Favorable consideration is respectfully requested.

Applicant believes that no fees are due in association with the filing of this and accompanying documents. If any extension of time is required, Applicant hereby requests the appropriate extension of time. If any fees are required, please charge those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-01100/EBM.

Respectfully submitted,


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Date: 5-23-03